University of Miami Independent System for Peer Review

Review Report

By

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1. Executive summary

Incidental capture of sea turtles in fisheries is one of the most significant threats to their survival and recovery. Possible management measures addressing the incidental take and mortalities of endangered and threatened sea turtle species by U.S. pelagic longline fisheries are active research areas in NOAA (National Oceanic and Atmospheric Administration) Fisheries. In 2001, NOAA Fisheries initiated a three-year cooperative research program in the western Atlantic Ocean to develop and evaluate fishing technology and tactics to reduce the incidental capture and mortality of sea turtles by pelagic longline gears. Recent results from this cooperative research program have been developed into a draft manuscript that is in urgent need of independent peer review given the intention to use the new information to modify the rules governing gear usage in the fishery. Therefore, the main goal of the review was to provide an in-depth evaluation of the quality of the research, data analysis, statistical procedures, and conclusions contained in the manuscript and supporting on-line information. The review revealed that the field study was both well coordinated and executed involving industry, observers and scientists. The experiment closely mimicked pelagic longline fishing operations in the area. The special attention turtles received, the appropriateness of the sampling design to address the objectives of the study, and the use of an *a priori* power analysis to determine the amount of fishing effort needed for the experiment were notable. Logistic regression analysis was used to examine how the catch rates of turtles as well as the probabilities of turtles being caught varied with changes in the values of the explanatory variables. It was conclusively shown that circle hooks and mackerel bait significantly reduced the bycatch of both loggerhead and leatherback turtles in comparison to the industry standard "J" hook baited with squid. Interaction effects were also demonstrated such that the combination of circle hooks and mackerel bait was even more effective in reducing loggerhead turtle bycatch. Circle hooks also significantly reduced the rate of hook ingestion by loggerheads. Catch rates of each species were also higher in warmer waters. The gear modifications that yielded the lowest catch rate of turtles had only a minimal effect on the target species relative to the industry standard. The draft manuscript is clearly suited for publication in the primary scientific literature. Several improvements to

the manuscript were suggested as well as recommendations for future research. One of the main issues is the fate of hooked/entangled turtles once released and the request for further comment on the observation that none of the turtles caught were previously tagged, bears importantly on this issue. Further options may also be possible in relation to the conduct of the longline fishery that can be explored with the available data. This could be achieved by broadening the analysis to include more explanatory variables such as vessel, time of year (seasonal effect), location within the Northeast Distant (NED) fishing area, hooks per set (ranged from 210-1173), swordfish catch, and environmental variables other than SST as predictors of turtle bycatch. Changing hook and bait type may indeed help in reducing bycatch rates but altering allowable fishing areas may be a more useful and effective solution. This possibility needs to be addressed. Finally, further research is recommended including repetition of the experiment, quantification of post-hooking/ entanglement mortality of loggerhead and leatherback turtles, and further experiments involving different gear modifications such as elimination of chemical light sticks and dyed bait.

2. Background

Incidental capture of sea turtles in pelagic longline fisheries is considered a threat to their survival and recovery. One of the prime fishing grounds for swordfish in the north Atlantic is the Northeast Distant statistical area (or NED). It has been completely closed to fishermen from the United States since 2001 and a reopening target of 55% reduction in anthropogenic mortality of both leatherback and oceanic stage loggerhead turtles was established. In 2001, NOAA Fisheries initiated a three-year cooperative research program in the western Atlantic Ocean to develop and evaluate fishing technology and tactics to reduce the incidental capture and mortality of sea turtles by pelagic longline gears. Data originating from the experiment in 2002 have been analyzed, interpreted and consolidated in the draft manuscript entitled, '*Catching fish, not turtles: Pelagic longlines'*, by John W. Watson, Sheryan P. Epperly, Arvind K. Shah, and Daniel G. Foster. The need for independent peer review of the manuscript was considered urgent in order to meet fixed deadlines for rule making and to expedite transfer of the research results to other countries. The consultant was approached to conduct an in-depth review of the manuscript and provide a written professional evaluation of the quality of the research, data analysis, statistical procedures, and conclusions contained in the manuscript (see attached SOW). The review was completed in three days by Dr. Kenneth T. Frank during the period 11-16 February 2004 in the cities of Dartmouth and Bedford, Nova Scotia, Canada.

3. Description of review activities

The review involved critical reading of the draft manuscript -- *Catching fish, not turtles: pelagic longlines.* While never explicitly stated, the format of the manuscript and reference to the URL for the journal *Science* suggested it was the intended journal. Supporting online material accompanying the manuscript was also reviewed. Several

references contained in the manuscript were examined and a general literature search of sea turtle / seabird / marine mammal bycatch was conducted. The most relevant literature generated from this search was reviewed. In 2001, a meeting was held by the Department of Fisheries and Oceans at the Bedford Institute of Oceanography dealing with the topic of turtle by-catch in Canadian Atlantic fisheries. The resultant summary document of this meeting provided some useful background material. The NOAA Office of Protected Resources web site contains several reports dealing with sea turtle protection and conservation and some of this material was examined. A number of contract documents were also examined, filled out in triplicate and subsequently mailed to Manoj Shivlani, Senior Research Associate, at the Center for Independent Experts (CIE), for which the review was conducted.

4. Summary of findings

Prior to the current study, data were somewhat weak to address measures to be taken to avoid/reduce turtle mortality in pelagic longline fisheries in the western North Atlantic. The present study has markedly changed this situation. The study was well coordinated involving industry, observers and scientists and closely mimicked pelagic longline fishing operations in the area. The special attention turtles received was notable. The sampling design was appropriate to address the objectives of the study and the use of an *a priori* power analysis to determine the amount of fishing effort (number of hooks per treatment) needed for the experiment was conducted as well. A supporting document provided details of the experimental design, data collection, sea turtle processing protocol, and statistical methods.

The statistical methods were clearly described. Logistic regression analysis was used to examine how the catch rates of turtles as well as the probabilities of turtles being caught varied with changes in the values of the explanatory variables. The logistic model appears to be the most appropriate for binary data with low frequencies of occurrence. Overall, the rigorous, mechanistic approach successfully teased out the significance of the treatment effects. Other studies involving the analyses of bycatch problems have used similar methodologies but a much wider array of potential explanatory variables (e.g. see Brothers et al. 1999). The supporting document would be greatly enhanced by including information on the spatial and temporal heterogeneity of the data. It would also be helpful if the logic/rationale for using temperature as a co-variable in the models was given.

The motivation for the present study is based on the fact that the “decline of sea turtle species worldwide or the failure of some species to recover is attributed, in part, to their incidental capture in fisheries” (page 3). Can anyone quantify (ballpark estimate) the amount of sea turtle mortality attributable to fishing? There is a lot of other stuff going on such as habitat destruction of nesting areas, pollution/toxicity, environment (climate change) and so on. It would be useful to express this uncertainty in the introduction.

In the present study the effects of hook type, sea surface temperature (SST), total soak time, and daylight soak time were examined. It was conclusively shown that circle hooks

and mackerel bait significantly reduced the bycatch of both loggerhead and leatherback turtles in comparison to the industry standard "J" hook baited with squid. Interaction effects were also demonstrated such that the combination of circle hooks and mackerel bait was even more effective in reducing loggerhead turtle bycatch. Circle hooks also significantly reduced the rate of hook ingestion by loggerheads. Catch rates of each species were also higher in warmer waters. The gear modifications that yielded the lowest catch rate of turtles had only a minimal effect on the target species – swordfish. This is good news for both the fishermen and the sea turtles. However, more can be done and could result in further options for consideration by the fishing industry and turtle conservationists.

It is possible to look at several other variables within the accumulated data set including vessel, time of year (seasonal effect), location within the NED fishing area, hooks per set (ranged from 210-1173), swordfish catch, environmental variables other than SST, and so on as predictors of turtle bycatch. The study by Witzell (1999) showed that in the NED fishing area the capture of loggerhead and leatherback turtles by the U.S. pelagic longline fleet peaked in September during 1992 to 1995. In another report (DFO, 2001), U.S. catch rates of leatherback off Newfoundland were highest in July and the best predictor of turtle bycatch on the Grand Banks was swordfish catch.

Standardized gear requirements included the use of green light sticks on every leader which could have been one of the treatment effects given its possible role in attracting leatherbacks to the gear. During fishing operations the processing of turtles was undertaken as time allowed, sometimes not until after haulback was completed. How much time was involved in these cases? What was the observer doing during haulback?

All animals were scanned for PIT tags and tagged as such if none were present. It was surprising that no animals were re-captured during the course of the experiment or that none had ever been tagged before. This observation deserves further comment.

How well does the fishing industry comply with the closure of the NED fishing area? Given that it is such a lucrative fishing area for large pelagic fish it must be tempting to fish in the area. Is there any information to address this concern?

Time/area closures were not explicitly considered nor were any analyses conducted to address this option (as stated above). Time/area closures are an accepted management measure to reduce turtle bycatch in the Hawaiian pelagic longline fishery where a two-month closure of a portion of the fishing ground exists as well as a prohibition of sets in shallow water. The authors of the manuscript did, however, acknowledge that a finer-scale approach is possible. It was stated in the conclusions that fishing tactics using real time sea surface imaging could be used to avoid turtle interactions by fishing in cooler waters. It would help to support this claim with further analysis. Changing hook and bait type may indeed help in reducing bycatch rates but altering allowable fishing areas may be a more useful and effective solution. Unfortunately, the spatial patterns of co-occurrence were not provided. It would be quite a simple matter to add this information to Figure 1. In addition, a crude numerical index of spatial aggregation (e.g., variance to

mean ratio) could be used to support the choice of lumping all the data together or segregating it accordingly. Similar arguments apply for temporal segregation of co-occurrence patterns. Hoey (1996) has noted that positive observations (capture of loggerhead or leatherback turtles on longlines) are clustered and contiguous in space and time and suggested that additive models be considered that independently model zero frequencies and positive observations.

An expected outcome of this study will be to re-open the NED closed area to the displaced U.S. longline fisheries. The study has demonstrated that the reopening criterion of a 55% reduction in the anthropogenic mortality of leatherback and loggerhead turtles has been met. In fact, while the bycatch was significantly lower with the modification to hook and bait type it appears that there were no mortalities given that all turtles were released alive. Is it possible that the exploitation of the target species themselves may be a contributing cause to the decline of turtles through some positive interaction (i.e. a commensalistic or even synergistic relationship?)

The magnitude of post-hooking/entangling mortality is clearly the most critical issue at this stage. Is it possible to quantify this mortality? Does the absence of any previously tagged turtles captured during the study raise concerns? Are there any estimates of the current population sizes of loggerhead and leatherback turtles? If all of the captured turtles in the studied died, what would be the likely impact on the turtle populations?

The overall conclusion that the "realized reductions in sea turtle bycatch are greater than is required in the current NMFS Biological Opinion to re-open the NED to U.S. fishermen" is very encouraging but similar studies need to be undertaken or the present one repeated. Further analysis of the study material as suggested would be a useful step as well. The final sentence of the manuscript suggesting that more research needs to be conducted on pelagic longline gear modifications is somewhat vague and narrow minded. Surely the authors can be more specific about fruitful additional research pursuits. Gear modifications could also include the manner of deployment in terms of season, region and depth, light stick use or not, dyed bait, etc. Mandatory use of observers or programs to train fishermen would appear to be essential as well. Further knowledge of sea turtle biology may be needed but little or no contextual information of this sort was presented in the manuscript.

5. Conclusion/recommendations:

The manuscript is suitable for publication in the primary scientific literature. One could ask – what is new or innovative about the study reported? Studies of the type reported here are not uncommon, and cooperative studies between fisheries science and the fishing industry are not new. Invention of the circle hook cannot be credited to the authors nor can the use of the two common bait types. If the authors are confident that adoption of the hook type/bait combination reported in their study by the international pelagic longline fishing community will arrest the decline of loggerhead and leatherback sea turtles in the North Atlantic then the results of this study should reach the widest possible audience. In

other words – will the results of this study make any meaningful/measurable difference to the endangered sea turtles in question? The current thrust of the paper is narrower than this in terms of having devised some technical measures to mitigate the interaction between pelagic longlines and bycatch of marine turtles. This is an important result that may not need to reach a very wide audience. Many of the concerns raised can be addressed with further analysis and they do not bear on the set-up (experimental design) or core (statistical) analyses presented in the paper. The manuscript could be strengthened by focusing on the various issues raised in the previous section.

Here are some suggestions for a few things that could be done in the future but would require additional research.

> Repeat the study because interannual variability in the occurrence of turtles in the area may be high and there is evidence to suggest this is indeed the case (see Table 2 in Witzell 1999). One must consider the results as preliminary until further fieldwork can be conducted. The Grand Banks is a physically dynamic area. The position of the Gulf Stream and its extension (the eastern boundary of the North Atlantic current) delineate frontal boundaries and eddy activity can be highly variable from year to year. The study by Polovina et al. (2000) illustrates the dependency of loggerhead turtles on oceanic fronts in the central North Pacific.
>
> Witzell (1999) demonstrated that the overall CPUE for leatherback turtles taken on pelagic longlines deployed in the NED fishing area using chemical light sticks was higher than the CPUE with vessels not using light sticks. The difference was close to 10-fold. Removal of the sticks would probably reduce the catch of the target species but it must be considered as one of the options given that leatherbacks are not attracted to the bait (either squid or mackerel) and are very rarely hooked. If it can be demonstrated that the post-entanglement mortality of leatherbacks is low then the use of light sticks would not be an issue.
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> Post-hooking/entanglement mortality of loggerhead and leatherback turtles needs to be quantified. Physiological/biochemical profiles of the captured animals needs to be assessed. Continued application of PIT tags and analysis of the associated database is advised. Further, it seems like a straightforward (albeit costly) matter to monitor the fate of a subset of turtles captured in the longline fishery through the use of transmitters configured in various ways.

6. References

Brothers, N., R. Gales, and T. Reid. 1999. The influence of environmental variables and mitigation measures on seabird catch rates in the Japanese tuna longline fishery within the Australian fishing zone, 1991-1995. Biol. Conserv. 88: 85-101.

DFO, 2001. Meeting on turtle by-catch in Canadian Atlantic fisheries. Canadian Science Advisory Secretariat, Proceedings Series 2001/17.

Polovina, J.J., D.R. Kobayashi, D.M. Parker, M.P. Seki, and G.H. Balazs. 2000. Turtles on the edge: movement of loggerhead turtles (*Caretta caretta*) along oceanic fronts, spanning longline fishing grounds in the central North Pacific, 1997-1998. Fish. Oceanogr. 9: 71-82.

Witzell, W.N. 1999. Distribution and relative abundance of sea turtles caught incidentally by the U.S. pelagic longline fleet in the western North Atlantic ocean, 1992-1995. Fish Bull. 97: 200-211.

Hoey, J.J. 1996. Distribution of pelagic longline fisheries in the western Atlantic ocean. pp 50 – 58, In: Pelagic longline fishery-sea turtle interactions: proceedings of an industry, academic and government experts, and stakeholders workshop held in Silver Spring, Maryland, 24-25 May 1994. NOAA Tech. Memorandum. NMFS-OPR-7, February 1996.

7. Appendices

a. Bibliography of all material provided

'*Catching fish, not turtles: Pelagic longlines'*, by John W. Watson, Sheryan P. Epperly, Arvind K. Shah, and Daniel G. Foster

Supporting online material for '*Catching fish, not turtles: Pelagic longlines'*

b. **Statement of Work**

Consulting Agreement between the University of Miami and Dr. Kenneth Frank

January 29, 2004

General

Incidental capture of sea turtles in fisheries is one of the most significant threats to their survival and recovery. Possible management measures addressing the incidental take and mortalities of endangered and threatened sea turtle species by U.S. pelagic longline fisheries are derived from research to design, develop, and evaluate gear and/or tactical measures capable of significantly reducing the interaction between sea turtles and longline fishing gear. In 2001, NOAA Fisheries initiated a three-year cooperative research program in the western Atlantic Ocean to develop and evaluate fishing technology and tactics to reduce the incidental capture and mortality of sea turtles by pelagic longline gears. This research program was successful in developing fishing techniques that significantly reduce the interaction of both loggerhead (*Caretta caretta*) and leatherback sea turtles (*Dermochelys coriacea*) with pelagic longline gear and tools and techniques to remove gear from the turtles that do interact with the gear. NOAA Fisheries is proposing rule making to require the use of this gear by U.S. pelagic fishers in the southeastern United States.

Pelagic longline fleets of other nations comprise over 90% of the longline fishing effort in the Atlantic. A major emphasis of the U.S. gear development research effort will be to transfer successful technology and encourage the use of practical measures to reduce sea turtle interactions by foreign fleets.

In order to provide information for rule making and technology transfer to other nations, a draft manuscript has been prepared, titled, '*Catching fish, not turtles: Pelagic longlines'*, by John W. Watson, Sheryan P. Epperly, Arvind K. Shah, and Daniel G. Foster. There is an urgent need for independent peer review of the manuscript in order to meet hard deadlines for rule making and to expedite transfer of the research results to other countries.

Specific

The consultant shall conduct an in-depth review of the manuscript and provide a written professional evaluation of the quality of the research, data analysis, statistical procedures, and conclusions contained in the manuscript.

The consultant shall review the experimental design and data analysis and provide written comments on whether the data and data analysis support the conclusion that the treatments tested significantly reduce the interaction of sea turtles with pelagic longline

gear under the conditions tested. Specifically, the consultant shall provide written evaluation of the appropriateness of the experimental design, the appropriateness of the statistical procedures used in the analyses of the data and whether the data and analyses support the conclusions. The consultant will also provide comments on additional research needed if appropriate.

The consultant's tasks, which will take a maximum of three days, shall consist of:

1. Conducting an in-depth review of the manuscript and providing a written professional evaluation of the quality of the research, data analysis, statistical procedures, and conclusions contained in the manuscript;

2. Completing a written report[1] (See Annex I) no later than February 16, 2004 and submitting it to "University of Miami Independent System for Peer Review" and sent to Dr. David Sampson, via email to david.sampson@oregonstate.edu and to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu.

[1] The written report will undergo an internal CIE review before it is considered final. After completion, the CIE will create a PDF version of the written report that will be submitted to NMFS and the consultant.

ANNEX I: REPORT GENERATION AND PROCEDURAL ITEMS

1. The report should be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the report should consist of a background, description of review activities, summary of findings, and conclusions/recommendations.

3. The report should also include as separate appendices the bibliography of materials provided by the Center for Independent Experts and the center and a copy of the statement of work.

Please refer to the following website for additional information on report generation: http://www.rsmas.miami.edu/groups/cie/